



COMCOR

AUTOMATIC

PROBLEM

VERIFICATION

AUTOMATIC PROGRAM VERIFICATION

- SIGNIFICANTLY REDUCES OPERATOR CHECK OUT TIME BY AUTOMATING THE STATIC CHECK PROCEDURE.
- VERIFYS THAT THE PROBLEM HAS BEEN PATCHED CORRECTLY AND THAT THE COMPONENTS ARE OPERATING.
- APV LANGUAGE IS SIMPLE AND EASY TO LEARN.

This program is available with all COMCOR hybrid computers where the digital subsystem has at least 8192 words of 24 bit core storage.

AUTOMATIC PROBLEM VERIFICATION (APV)

The purpose of this program is to provide the hybrid computer programmer with a convenient method of performing static checking of the analog portion of his study. The static checking insures that his program is patched as he has specified, and that the computing components being used are operating correctly.

The language which the programmer uses to specify his conditions and interconnections has been chosen to be as convenient as possible and yet retain a similarity to other existent languages. The reader will quickly recognize the similarity between the APV language and FORTRAN. This similarity is only in syntax; the two languages have different purposes and, therefore, their meaning is different.

Static checking can be performed in different ways. APV leaves the choice of how it is to be done entirely in the programmers hands. He may choose to check each piece of equipment based upon the inputs to that piece of equipment or, at the other extreme, to check only the initial derivative or integrand of each integrator based upon the initial conditions. In either case, passing the test assures him that his patching is correct and that the components he is using are operating correctly.

DEFINITIONS

The APV language has two types of variables: system names and programmer-defined variables.

SYSTEM NAMES

The system names consist of one or three letters followed by an integer number, in the range of zero through 999, enclosed in parenthesis. The three-letter and equivalent one-letter codes that form a part of the system name are given below.

<u>3 letter code</u>	<u>1 letter code</u>	<u>Function</u>
AMP	A	Amplifier
INT	I	Integrator
POT	P	Potentiometer
MUL	M	Multiplier
RES	R	Resolver
FUN	F	Variable Function Generator
DAC	none	Digital to Analog Conv.
ADC	none	Analog to Digital Conv.
TNK	T	Trunk Line
SET	S	Potentiometer Coefficient

The variable name refers to the ratio of the output voltage to reference voltage that appears on the output of the component indicated. For the case of the integrator, this is the equivalent voltage if it were summing its inputs. That is, it is a measure of the integrand or initial derivative.

PROGRAMMER-DEFINED VARIABLES

A programmer-defined variable consists of 1 to 4 alphanumeric characters, the first of which must be a letter.

CONSTANTS

Constants within the APV languages are of floating point form and consist of up to eight decimal digits. All constants must include a decimal point.

ARITHMETIC OPERATORS

The arithmetic operators within the APV language consist of + (addition), - (subtraction), * (multiplication), and / (division). In the absence of clarifying parenthesis, the hierarchy of operations follows the FORTRAN convention of:

1. Multiplication and Division.
2. Addition and Subtraction.

Operations of equal precedence are grouped from left to right.

FUNCTIONS

The system contains functions which match functions performed by components within the analog computer. These functions are listed below:

SINF	The SINF of the argument scaled equivalent to the analog component.
COSF	The COSF of the argument scaled equivalent to the analog component.
TANF	The tangent of the argument at the analog scaling.
ASIN	The inverse cos-function scaled the same as the analog computer.
ACOS	The inverse cos-function scaled the same as the analog.
ATAN	The inverse tangent function scaled the same as the analog.
SQRT	The square root function.
ABSF	Absolute value function.

COMP

A logic function (comparator)

- has a value 1.0 if the argument is greater than zero, otherwise its value is zero.

VFUN

An arbitrary function which the programmer has previously defined.

PROGRAM STATEMENTS

Program statements have as their function either setting up some portion of the analog computer, testing some position of it, or assigning a value to a programmer-defined variable. They have the form:

variable = expression

where an expression consists of variable, constants and functions combined in a meaningful way with the arithmetic operators.

The set-up commands are involved with the potentiometers, digital-to-analog converters and the variable function generators. They have the form:

SET () = expression

DAC () = expression

SFUN () = expression involving the arbitrary function

VFUN

These statements will cause the appropriate device to be set to a value equal to the expression.

Examples

SET (3) = .7132

will cause potentiometer 3 to be set to the coefficient .7132

DAC (6) = ALFA*BETA/10

will cause the voltage ratio on digital-to-analog converter 6 to be set to the value indicated by the expression.

The program statements which cause checking to be performed have for the variable any system name other than SET or DAC.

Examples

AMP (6) = MULT (3) + AMP (5)
* FUN (2)

This will cause amplifier 5 and function generator 2 to be read, their product formed and added to the value read for multiplier 3. This resultant value is then compared with the value read for amplifier 6. If they agree to within a prescribed tolerance, the program continues.

Otherwise, an error message is outputted and the program continues.

MISCELLANEOUS STATEMENTS

There are several miscellaneous control and defining statements within the APV language. These are defined in following paragraphs.

Assign Statement

Form: ASSIGN (VAR₁, VAR₂) (VAR₃, VAR₄)

This statement causes VAR₁ to be replaced with VAR₂ whenever VAR₁ appears in subsequent statement. Thus, this statement may be used as a replacement statement if hardware is replaced or to permit the use of programmer-defined names in place of equipment designators (system names).

Examples

ASSIGN (POT (7), POT (107))
(BETA, A (16))

Whenever the program encounters the variable POT (7), it will know it is really POT 107; similarly, the variable BETA will be interpreted as amplifier number 16. This

latter case is to be distinguished from the program statement:

BETA = AMP (I6)

which will assign the value of amplifier I6 at the time that the program encounters this statement to the variable BETA.

Console Selection

The selection of the analog computer to which the subsequent statements apply is controlled by the console select statement.

Form: SELECT CONSOLE N

Example

SELECT CONSOLE 2

will cause all subsequent statements to refer to analog console number 2.

Mode Control

Within the APV language, mode control is accomplished by the MODE statement.

Form: MODE (code)

Limit Function

A limit function is provided to handle the situation where a limiter is used around an analog element.

Form:

Variable = Expression, LIM (UL, LL)

Where the expression is evaluated and then checked to see that it lies between the upper limit and the lower limit. If it does not, the value of the expression is replaced with the appropriate limit value prior to testing or replacing the variable.

Comments

The programmer may insert comments at any point he wishes by putting a C in column 1. APV takes no action on the comment, but prints it on the typewriter or line printer.

PROGRAM EXAMPLE

The following figures illustrate the use of APV in performing a check on typical analog patching. The mechanization of the analog problem is shown in

figure 1. No effort has been made to make this a reasonable mechanization. It has simply been constructed to use several different types of circuits. The APV PROGRAM is shown in figure 2.

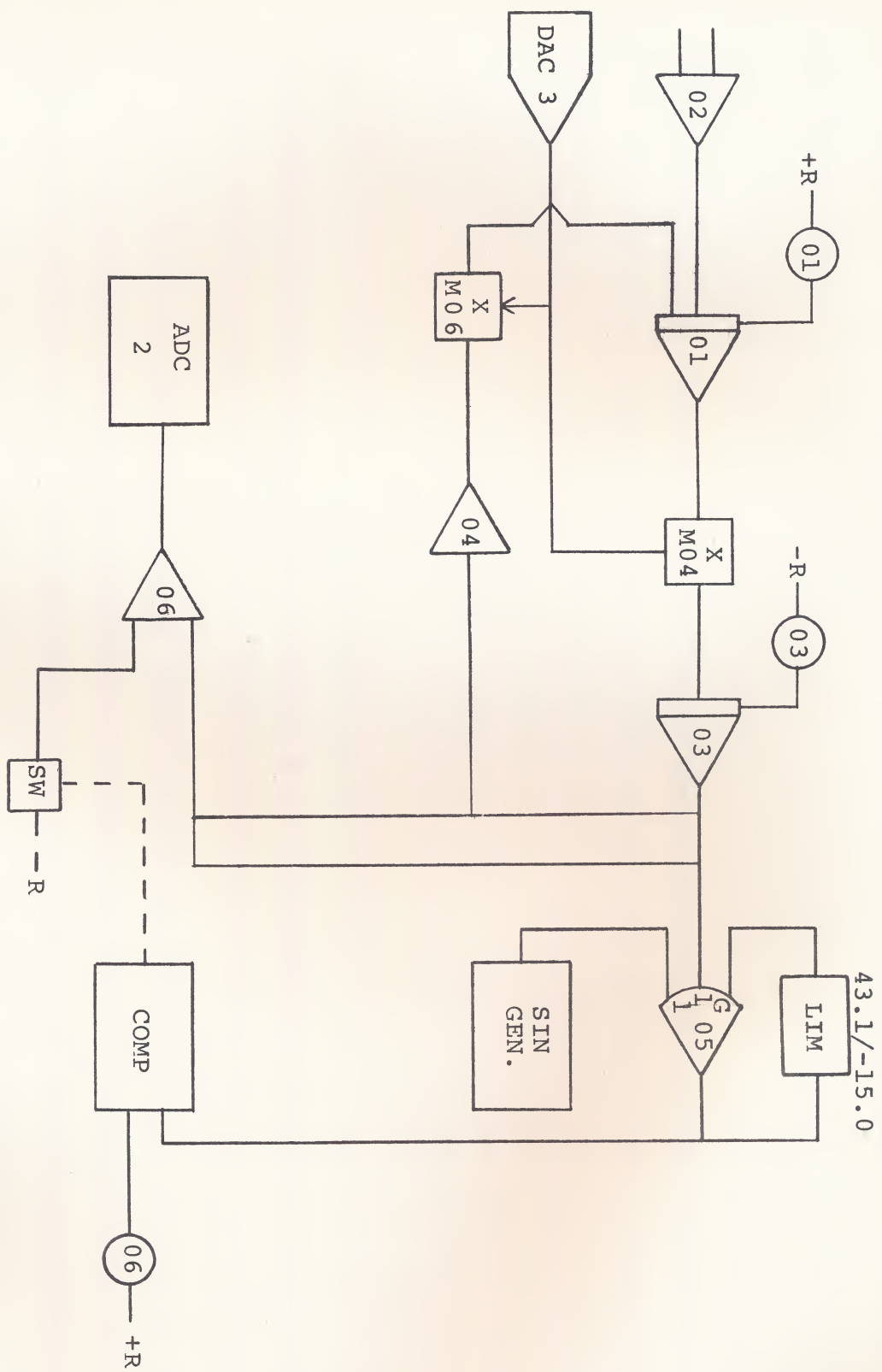


Figure 1. APV Test Circuit

C FOR COMMENT		STATEMENT NUMBER	10	15	20	25	30	35	40	45	50	55	60	65	70	72
C		APV	PROGRAM FOR CHECKING TEST CIRCUIT													
		SELECT	CONSOL 1													
C		ABOVE STATES	PROBLEM IS ON ANALOG CONSOLE NUMBER 1													
		BETA=1.6														
		GAMA=1.3														
		SET(1)=.6147														
		SET(3)=.2105														
		SET(6)=.0150														
		DAC(3)=BETA*GAMA/10.														
C		THESE STATEMENTS SET UP THE POTS AND DAC														
		INT(1)=SET(3)*DAC(3)-AMP(2)														
C		THIS CHECKS INPUT OF AMP(1) FROM POTS, DAC,3 AND AMP,2														
		INT(3)=SET(1)*DAC(3)														
C		ABOVE CHECKS INPUT OF AMP,3 FROM POTS,1 AND DAC,3														
		AMP(5)=ASIN(-AMP(3)),LIM(.4310,-.1500)														
C		THIS CHECKS AMP,5,THE LIMITER AND THE SIN GEN														
		ADC(12)=-AMP(3)+COMP(POTS(6)+AMP(5))														
C		THIS CHECKS THE INPUT TO ADC,2 BY USE OF THE LOGICAL COMP FUNCTION														
		END														

Figure 2. APV Program

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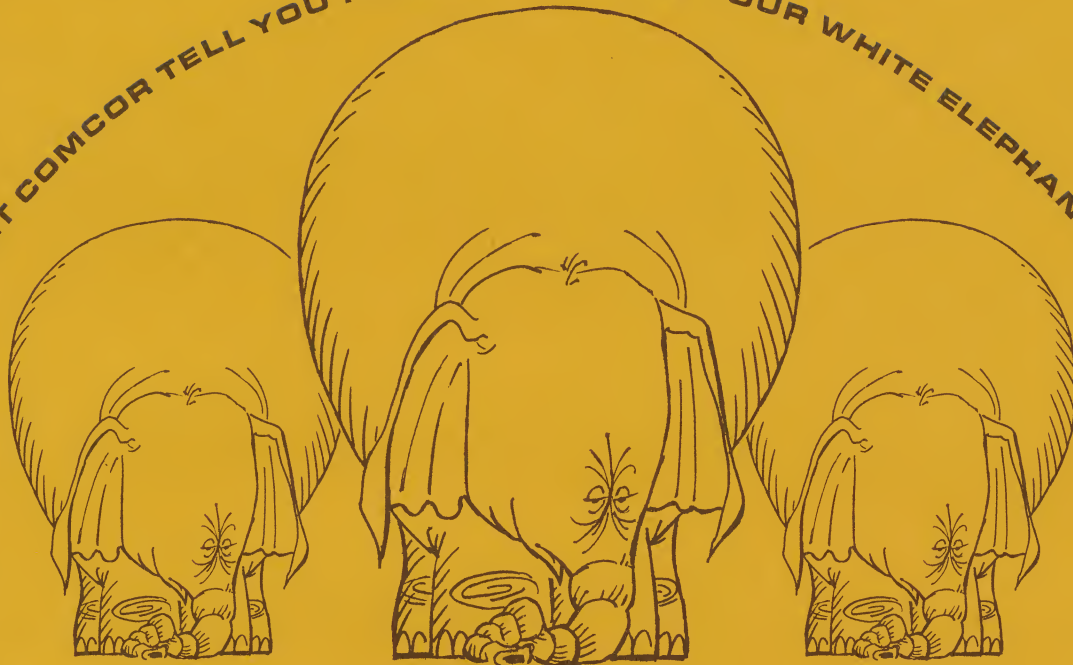
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